Northern Region Landbird Monitoring Program

2005 Flammulated Owl Surveys
Final Report

Photo K. Smucker

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INTRODUCTION

LANDBIRD MONITORING PROGRAM OVERVIEW

In 1994, the Northern Region of the USDA Forest Service (USFS) initiated a region-wide Landbird Monitoring Program (LBMP) so that managers might better understand the habitat relationships of landbirds that breed in the northern Rocky Mountains and, in the future, might be able to assess longer-term landbird population trends. The program was initiated to help the USFS meet its legal mandate (National Forest Management Act of 1976) to monitor populations of "indicator" species as a mechanism to maintain viable populations of native vertebrates. Combining data from multiple Forests permits an assessment of trends and habitat relationships over the larger Region and provides an indication of changes in relation to land management practices.

The Landbird Monitoring Program not only collects habitat data from permanent monitoring points so that correlations with land use and cover type can be determined, but also conducts short-term studies on the effects of specific management practices on selected bird species (see http://avianscience.dbs.umt.edu/research_landbird.htm). In 2005 the LBMP was asked to focus on a single species and develop and test a regional monitoring survey for Flammulated Owls.

FLAMMULATED OWL SURVEY OVERVIEW

The Flammulated Owl, *Otus flammeolus*, is considered a sensitive species in USFS Region 1 and a Montana Species of Concern. Prior to this season, there had never been a systematic survey for this migratory owl in Region 1, and the extent of its distribution was not understood. Because Flammulated Owls do not arrive on their breeding grounds until early to mid-May, they have historically been missed in nocturnal owl surveys. They also seldom vocalize except at night and are rarely seen.

The primary purpose of the 2005 efforts was to document the breeding season distribution of Flammulated Owls (abbreviated Flams) across Region 1, especially on a district by district basis where potential habitat exists (see below). Our main goals were to:

- Document Flammulated Owl distribution in Region 1 via broadcast surveys during the breeding season,
- Develop, test, and refine a Flammulated Owl monitoring protocol for R1,
- Establish annual survey routes on all relevant Districts,
- Continue a portion of survey routes previously established (only on some Districts),
- Assess detection probability (using some Forests),
- Set the ground work for more extensive studies on specific habitat needs, specifically how these owls may be affected by land use practices, particularly thinning projects.

FLAM DISTRIBUTION AND HABITAT ASSOCIATIONS

Detailed compilations of Flammulated Owl distribution and ecology for this region can be found at the MT Fish Wildlife and Parks Animal Guide web site (http://fwp.mt.gov/fieldguide/detail_ABNSB01020.aspx) and have been summarized by the MT Bird Conservation Partnership / Partners in Flight (http://biology.dbs.umt.edu/landbird/mbcp/mtpif/mtflow.htm). The Birds of North America Species Account for the Flammulated Owl also provides a detailed resource (McCallum 1994b).

Distribution: During the breeding season (May-August), Flammulated Owls have been found from southern British Columbia to Oaxaca in southern Mexico (McCallum 1994). They occupy suitable habitat (see below) throughout northern Idaho and western Montana. Montana Bird Distribution notes a few confirmed Flams near Missoula, Helena, and Bozeman (Lenard et al. 2003). The map of occurrence records below (Figure 1) is generated from the Montana Bird Distribution Database (a similar map is unavailable for North Idaho).

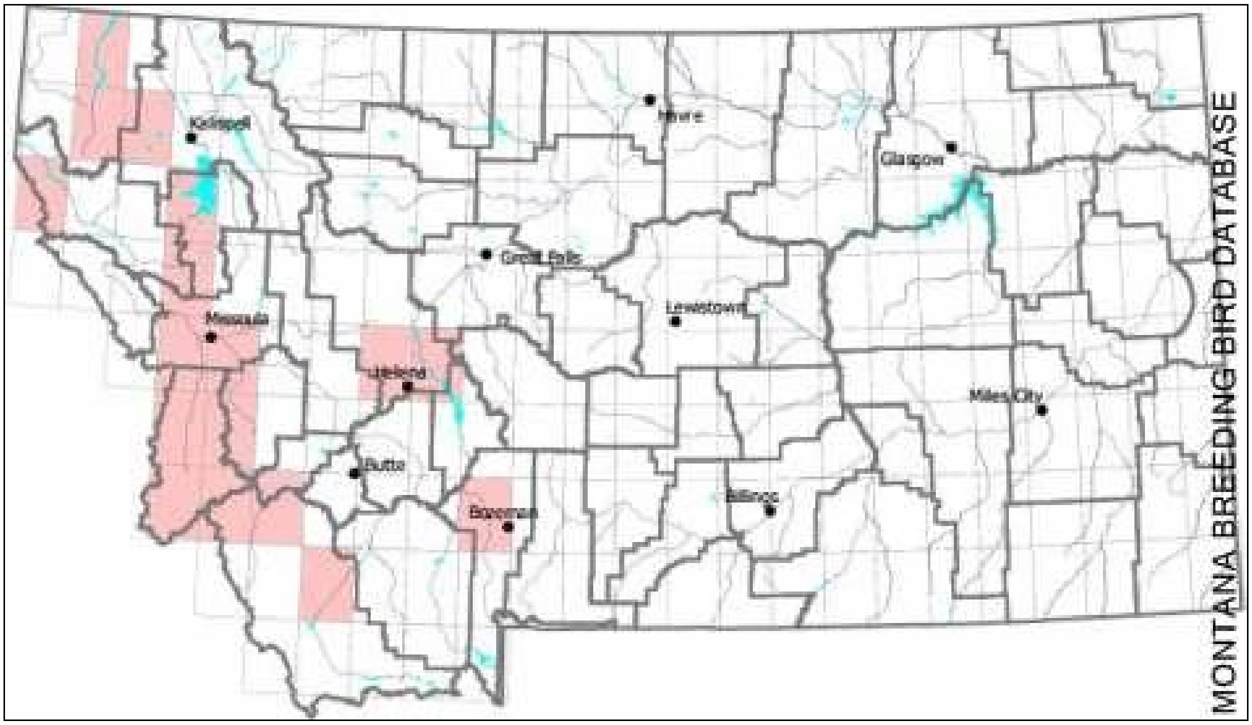

Fig 1. General distribution of Flammulated Owls in Montana based on occurrence records (pink areas). http://fwp.mt.gov/fieldguide/detail_ABNSB01020.aspx

In the past 15 years, there have been localized surveys for Flams in North Idaho and Montana west of the divide. The Bitterroot, Clearwater, Kootenai, Lolo and Nez Perce NFs have all engaged in some survey effort. Additionally, for her Master's research, Vita Wright surveyed for owls in 1994 and 1995 primarily on the Bitterroot NF (and small portions of the Lolo and Beaverhead-Deerlodge NFs). Although a smattering of occurrence records exist, National Forests east of the Divide had no systematic surveys for Flammulated Owls and, prior to this season, were unclear whether or not this species occurred within their forest boundaries. The fact that the first Flam nest in Montana was not found until 1986 (Holt et al. 1987) is also a testament to how little historical knowledge regarding Flams in this Region exists.

General Habitat Associations: Flammulated Owls in the Northern Rockies of the western US and Canada have been found primarily in low to mid-elevation montane forests with low to moderate canopy closure, a large tree component, and snags (McCallum 1994b) – structural characteristics associated with older forests. Although older Ponderosa Pine forests and shade intolerant Ponderosa Pine / Douglas Fir forests appear to be favored (Linkhart and Reynolds 1997), they have also been found breeding in older Douglas Fir forest types and, to lesser degree and locally, in grand fir, western larch, spruce/fir and lodgepole pine dominated habitats. Mature quaking aspen stands have also been known to harbor breeding Flams (McCallum 1994b. Marti 1997), though these have rarely, if ever, been surveyed in this Region.

Flammulated Owls are found where there is an abundance of nocturnal arthropod prey, specifically Noctuids, which are large, cold-hardy nocturnal moths that appear more abundant in spring and summer than other arthropods (McCallum1994a), and there is evidence that these are more abundant in pondersa pine/Douglas fir forests than other western conifer forest types (Reynolds and Linkhart 1987).

Flams require large snags with cavities (commonly Pileated Woodpecker, Northern Flicker, or sapsucker holes) for nesting, although they have been known to use nest boxes. They appear to require relatively open areas, or patches of openings (for foraging), in combination with dense patches of usually younger trees or dense foliage (e.g., mistletoe) for roosting. Optimal areas may be the transition between mesic and xeric sites where large snags are found near stands of Douglas-fir regeneration and small grassy openings. Wright (1996) found that Flams in western Montana avoided mesic old growth ponderosa Pine or ponderosa pine / Douglas Fir stands (ie., those with a *Vaccinium* understory), and that landscape level habitat features influenced Flam presence (e.g., occurring in areas with a higher proportion of low / moderate canopy cover assessed at a landscape scale). A habitat modeling study in the Kamloops area of British Columbia in Douglas-fir/ponderosa pine forest type found three variables to be significant predictors for Flam occupation: elevation (between 850 and 1,150 meters), age class (older stands), and canopy closure (40 to 50 percent; Christie and van Woudenberg 1997).

METHODS

There were 3 main components to the season's efforts.

1. Determine survey areas, schedules, surveys names/#s, and basic directions to sites.
2. Locate and document survey points; collect habitat information (by walking during daylight hours).
3. Conduct nocturnal broadcast surveys for Flammulated Owls.

DETERMINING FLAMMULATED OWL SURVEY AREAS

We targeted potential habitat to determine survey sites, keeping the definition of potential habitat broad. Surveying via a completely random design across Forests would have likely placed a large proportion of routes in forest types or conditions with little to no chance of harboring owls, Thus, we targeted forest conditions likely to be used by Flammulated Owls and yet simultaneously tried to cast a wide enough net to increase our understanding of its distribution.

Surveys routes provided for technicians were generated in one of two ways. The first were non-randomly selected areas/routes that had either been previously surveyed or were areas a Forest biologist was interested in having surveyed. The second type were randomly selected sites chosen via a GIS computer exercise that combined vegetation layers specific to each Forest together with road and trail layers (considering travel location and status).

Initial attempts at using Region-wide vegetation layers (e.g., R1-VMP, SILC) in our GIS modeling exercises proved inadequate because these layers were insufficient at locating forests with low canopy cover. Instead, we used the best available vegetation layers for each Forest (these ranged from Vegetation Response Units to TSMRS stand data to synthesized old growth layers). From these, we selected for the appropriate tree species, age, and canopy closure (depending on available variables). The Helena and Idaho Panhandle NFs had already developed a Flammulated Owl layer, which we incorporated. We then used a neighborhood analysis GIS modeling exercise for site selection that took into account *amount* of selected habitat stands in an area. This allowed us to survey those areas with more widespread owl habitat and avoid small stands of potential habitat surrounded by inhospitable habitat. Because the surveys would occur at night and technicians would generally work solo, we also restricted possible stands to those within 500 meters of roads or trails. Final shape files generated for each forest will be posted on our web site.

GENERAL FIELD PROCEDURES

The logistics associated with this field effort were not a trivial concern. Nocturnal surveys add a particular challenge not associated with most field work, and as this was a pilot season, route access and other details needed to determined.

We held a 3-day training at the St Regis bunkhouse, Lolo National Forest. We reviewed and tested protocol and completed first aid and defensive driving courses. Safety related to working at night was strongly emphasized (e.g., necessary equipment, working in pairs when conditions dictate, scheduled daily radio check-ins, bears, mountain lions, and night driving).

Field technicians conducted one transect per day/night, the order of which was determined as instructed below. Technicians camped in the vicinity of the transects and moved camp every 1 to 2 nights in order to minimize night-time travel time. Work centers, trailers, or cabins were sometimes used for nearby transects, rain days, or weekend housing. For safety reasons, field radios were provided, and those who worked solo arranged a schedule for checking in with their contact in the local District or Forest office.

THE THREE SURVEY COMPONENTS:

1) DETERMINING SURVEY AREAS, SCHEDULES AND DIRECTIONS TO SITES

Technicians created a tentative schedule that spread surveys geographically in order to avoid relegating any one district to late-season (when detection rates may diminish). A truly random schedule would be logistically inefficient. In general, geographically close surveys were lumped such that technicians spent 2-4 days in a region and then moved to a new area (usually a new district) with the target of completing some surveys in each district before June 15 (~ half way through the season).

Each survey area was given a unique transect number and name. Sets of orthophoto maps and Transect Location Forms for each transect were organized in 3-ring binders, along with the Forest travel maps which provided an overall index of transect locations.

All routes were given a unique survey name and number. For randomly selected routes, the number is 3 or 4 digits total - the official forest number (1 or 2 digits) followed by the number given when the survey was selected (01- 99). Non-Random route numbers are 4 or 5 digits depending on the forest – the Forest number followed by 9 and then 2 digits beginning with 01 and given sequentially. Transect names were simply unique names based on the road or an obvious geographic feature.

2) LOCATING SURVEY POINTS; COLLECTING HABITAT DATA
Once the general site and directions to start point were determined, technicians traveled to the survey, completing the Transect Location Form (noting specific directions and distances).

For randomly selected transects, surveyors generally noted appropriate habitat for surveying as they approached the "selected stand". This stand did not need to be the first survey point, but was no greater than point 8 (to be sure it is completed). GPS coordinates were used to clarify position when necessary. At times it was most efficient to drive the entire route to get an idea of available habitat (see below) and then return to the start point to begin establishing points. For pre-established non-random transects, technicians were able to start surveying upon arrival, without first driving the route.

Survey locations (stops) were established every 500 meters as long as habitat remained. Technicians walked, using their GPS unit to determine this distance (using *distance to previous waypoint*), recorded the GPS waypoint and location, and placed a "bright eye" reflective tack in a visible spot. These tacks greatly reduced the time it took to relocate the point at night. Transect length varied depending on available habitat and timing – we aimed for at least 8 points and as many as 15, depending on the amount of available habitat and time permitted.

As mentioned earlier, we did not want to be too specific as to what was "potential Flam habitat". In general, technicians established points in forested habitat, placing the first point in or near the selected stand. Burned forests were considered habitat as long as some trees remained (e.g., salvage logging did not take all large trees). Very large treeless areas were skipped. If less than 7 points were set up, technicians were instructed to locate an additional area nearby and continue surveying.

DATA COLLECTION: The format and explanations for entering data in the field data forms are provided in the tables below. More information regarding data collection is available in the 2005 Methods Manual (available, along with the data forms, at http://avianscience.dbs.umt.edu/research_landbird_flam.htm)

Table 1. Instructions for recording information on top of the data forms.

VARIABLE	EXPLANATION
OBS	Observer - first 2 initials, write out last name (3 initials on subsequent pages).
FOREST	2-digit code (Appendix IV)
DISTRICT	2-digit code (Appendix IV) – leave blank if unknown
DATE	Use 1 column for month and 2 for day (year is given); 617 = June 17, 2005.
TRANSECT NUMBER	For Random - # are given. For Non-Random, give each a 4-5 digit #: forest number + 9 + sequential 01, 02 etc.
TRANSECT NAME	Unique name you give the transect (usually based on road or other geographic feature or as it appears on the Transect Location Form).
# obs	Number of observers present for owl calling

Table 2. Instructions for recording information for point location and habitat component

VARIABLE	EXPLANATION
WAY POINT	GPS way point provided from unit (for uploading data from unit)
LATITUDE	In decimal degrees – include here even if you plan to upload info
LONGITUDE	In decimal degrees – include here even if you plan to upload info
CT 1	Cover Type 1 – description of main cover type. If 2 cover types of equal area, does not matter which is 1 and which is 2.
CT 2 (?)	Cover Type 2 – description of secondary cover type (if present)
STRUCTURE	NH – nonhabitat, Y – young, M – mature, OG – old growth, Scut – selectively cut. *See below for further description.*
stumps SM LG FEW LOTS	If Scut above, assess stumps: sm – most are small, lg – most are large, few – light logging, lots – heavy logging. *See below for further description.*
CANOPY CLOSURE	Assess the degree of canopy closure (open/dense forest) around the point. *See below for further description.*
PRIMARY TREE SP	Provide 4-letter code for the most common tree species in the canopy. *See below for codes.*
%	Percent of canopy trees that are composed of this primary tree species (up to 100 %)
SECOND TREE SP	Secondary tree species – the second most common in the area.
%	Percent of canopy trees composed of this secondary tree species – together with primary should add up to about 100% unless a third type present
CIRCLE	Sketch road and mark CT1 and CT2. Add Flam later.

GPS COLLECTION AND RECORDING

It was a priority to obtain accurate GPS data for each point and to collect these data in the same format and datum study-wide. We used Garmin eTrex Legend GPS units and recorded the GPS information in latitude / longitude decimal degrees (e.g., 47.26896 -114.58936) in WGS 84. We recorded the waypoint number on the data forms – we did not enter the stop point # in the unit. At season end, these waypoints and lat/longs were downloaded and matched with recorded waypoints. We left no permanent markings along the routes.

HABITAT VARIABLES

Measures of vegetation structure were recorded at each point as the transect was set up. We recorded all habitat information within an ~ 200-m-radius circle (smaller if topography limited view of area). These vegetation data were collected for two reasons: (1) such detail is unavailable through remote sensing but may be useful to classify points according to elements thought important to Flammulated Owls and, potentially, to help explain changes in occupancy over time; and (2) measurements can provide additional data that will help with the verification of vegetation cover types that are being mapped by GIS. In most cases habitat information was collected at every point. However, if time did not permit, technicians were instructed to skip this data collection and begin owl surveys.

3) NOCTURNAL SURVEY FOR OWLS WITH BROADCAST CALLERS

START AND FINISH OF A TRANSECT

The first owl count of the day began ~15 min after sunset (21:45 – 22:30, Mountain Standard Time (MT), or 20:45 - 21:30 Pacific Standard Time (ID). Thus, counts began just after dark and continued until the requisite stops were completed (8-15, depending on available habitat or surveyor schedule).

UNACCEPTABLE FIELD CONDITIONS

Surveys were not conducted when the weather was bad enough to significantly influence the ability to hear owls (e.g., continuous rain or wind that is constant and of enough strength to bend the tops of trees [Beaufort 5]). If confronted with such conditions during the survey, technicians waited up to 2 hours for conditions to improve. If that night's survey was cancelled and schedule permitted, they returned the following day. If conditions remained poor, they moved on to the next scheduled survey. Flammulated owls have been known to NOT respond to callers during inclement weather (V. Wright, pers. comm); presumably they are too focused on acquiring food to defend territories.

DATA COLLECTION

Table 3. Instructions for completing the broadcast calling section of surveys.

VARIABLE	EXPLANATION
STOP	Stop (point) number, should always run from 1 to 15 (or greater)
TIME	Use the 4-digit military time-of-day the count is started at point; e.g., 2210.
WIND	Use the Beaufort wind scale codes (0-5) as defined below.
SKY	Use the codes (0-4) as defined below.
TEMP °F	Use thermometer to record air temperature to the nearest degree or 2 (Fahr.)
NOISE	Use the codes (0-4) defined in below for description of stream or other CONSTANT noise (and its probable effect on bird detectability). Intermittent noise is NOT considered here but should be noted in the comment section.
FLAM 1 N Y	Presence of 1 FLAM – circle No or Yes. If no, DONE. If yes – continue
FLAM 2 N Y	Presence of a second FLAM – circle No or Yes. If no, DONE. If yes – cont.
FLAM 3 N Y	Presence of third FLAM – circle No or Yes. If no, DONE. If yes – continue
B4 call: Y N	Was owl detected before the caller (first 2 minutes)?
After call: Y N	Was FLAM detected after the caller was started?
# MIN	# of minutes from the start that it took to first detect FLAM (if not detected until after caller used, time is at least 2 minutes).
CT - 1 2 UNK	Circle which cover type owl found in. Use UNK if unknown
DIRECTION	The approximate compass direction to the detected owl
DISTANCE	The approximate horizontal distance to the owl
INCIDENTALS	Other owl species detected and any brief info regarding these – though we call them "incidentals" they are important!
COMMENTS	Did you see the FLAM, find nest, triangulate to determine distance, etc…

EXT CALL	Circle Y if extended call (pts 2, 4, 10) SEE BELOW

Technicians spent 6 minutes listening and calling for owls: two minutes of silent listening, followed by 1 minute of broadcast hooting using FLAM call on Foxpro F48 broadcast caller (15 seconds positioned in each cardinal direction), followed by 3 minutes of post-broadcast listening. Broadcasting was still done even if owls are heard in the first 2 minutes. To test whether our length of broadcast calling was sufficient, on stops 2, 4 and 10, technicians stayed an extra 4 minutes, repeating the broadcast call and listening period. If a survey point was not completed because of some disturbance or weather event, this was noted and the point not counted.

DATA ENTRY and SEASON-END

Most technicians completed data entry while still employed by their respective Forests, using the excel entry form provided. An ASC work-study employee completed the data entry, organized all field and data forms and maps, and checked all data. All technicians completed an exit interview with the ASC.

RESULTS

All data are available for download, either Region-wide on a Forest by Forest basis, at http://avianscience.dbs.umt.edu/research_landbird_flam.htm.

SURVEY EFFORT

The 2005 Region 1 survey primarily relied on paid, seasonal technicians employed by the Forest Service. On 10 of the 12 Forests in Region 1, seasonal technicians completed the surveys. FS biologists completed all surveys on the Flathead and Gallatin NF and assisted on the Lolo and Custer NFs. ASC staff completed 10 transects.

In general, there was one technician hired per Forest. However, 2 technicians covered the Kootenai NF and northern ½ of the Idaho Panhandle NF, and 2 technicians covered the Nez Perce NF, Clearwater NF and southern ½ of the IPNF. Because of limited potential habitat, efforts were reduced on the Flathead and Gallatin NFs. The Flathead surveys were completed on the best available habitat only on the Swan Lake and Tally Lake RDs (J. Ingrebretson). On the Gallatin, 4 surveys were completed on the Livingston RD (R. Figley) and 4 on the Bozeman RD (B. Dixon). On the IPNF, Gonzaga University student volunteers also conducted13 surveys on Coeur d'Alene River RD (J. Taylor), and the Lolo NF completed additional surveys (D. Wrobleski). These later two efforts are not included in these reults (the former did not provide useable spatial data, and the later will be incorporated as soon as data system transfer occurs).

We surveyed for owls May 9–July 21, with the majority of surveys completed May 15– July 15. Most technicians worked alone when surveying along roads and worked in pairs along trails. They generally set up transects during the day by walking, and surveyed for owls at night by driving (when feasible). Transects averaged 10 points per route (most were 8-15; range 3-20 points).

We surveyed 265 transects (or survey routes) across the Region, and resampled 59 of these during the second ½ of the seasnon (primarily on 5 forests, see Table 1). Approximately 30% of the transects were selected non-randomly, with the remaining transects randomly selected from our GIS modeling exercise.

Table 1: Survey effort per National Forest in Region 1.

FOREST	# of transect	# random transects	# transects resampled	# points
BEAVERHEAD-DEERLODGE	17	10	0	171
BITTERROOT	30	17	10	281
CLEARWATER	22	18	0	256
CUSTER	22	17	0	252
FLATHEAD	10	0	0	93
GALLATIN	8	4	0	76
HELENA	25	23	9	260
IPNF	14	9	0	156
KOOTENAI	38	30	13	377
LEWIS CLARK	22	18	3	184
NEZ PERCE	25	22	15	312
LOLO	32	17	9	277
TOTAL	**265**	**185**	**59**	**2695**

FLAMMULATED OWL DETECTIONS

We located owls on all but three of the National Forests in this Region; no owls were detected on the Lewis & Clark, Custer, and Gallatin National Forests (Figures 2 and 3). We have created an ArcIMS mapping site in which all survey points are displayed according to whether there was an owl detected or not. See http://avianscience.dbs.umt.edu/arcims_info.htm.

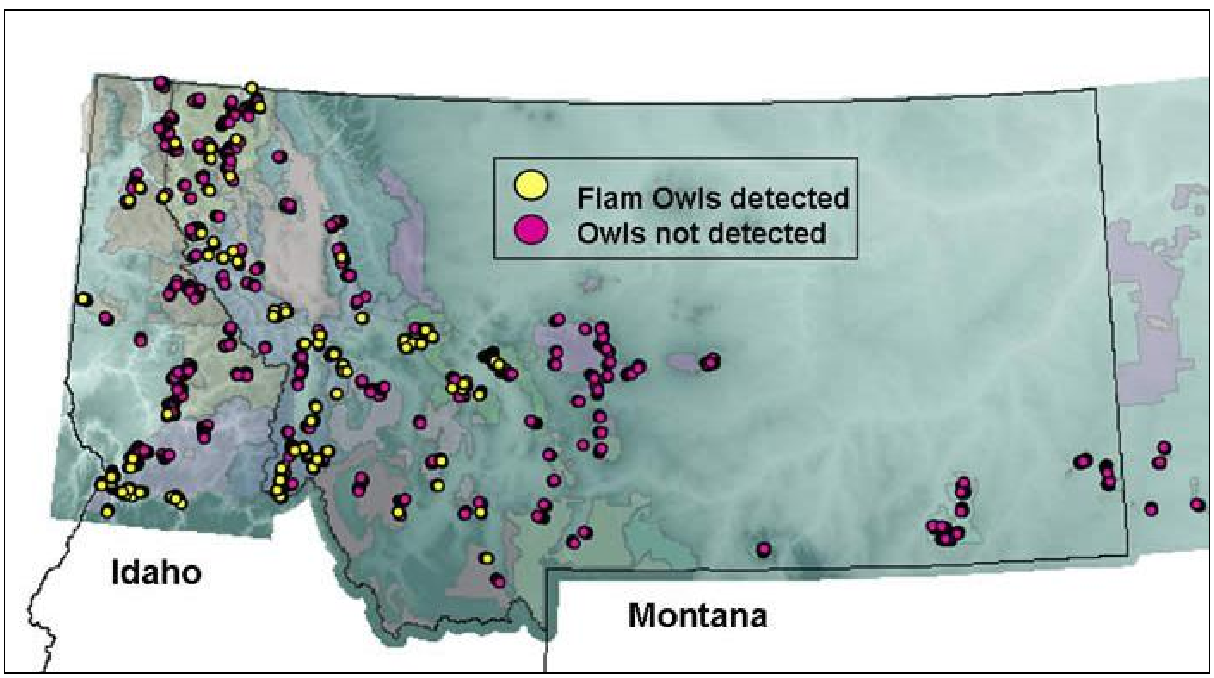

Fig. 2. Region-wide map of Flammulated Owls detected / not detected May-July, 2005

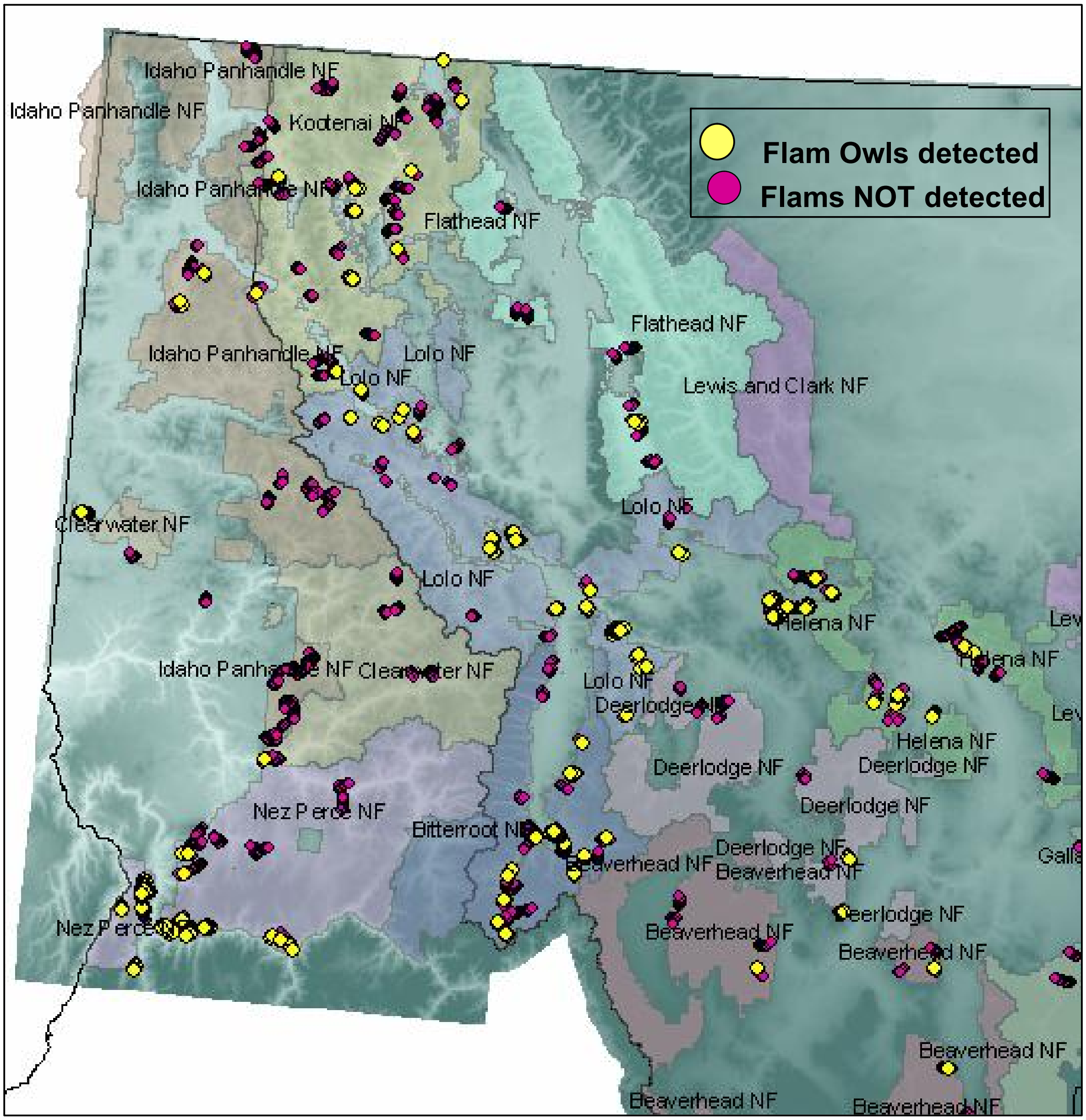

Fig. 3. Map depicting each National Forest with positive Flammulated Owl detections.

We detected Flammulated Owls on a total of 78 transects across the Region (see Table 2). On transects with owls, the number of points on which owls were detected ranged from 1-12 (mean = 2.46; median = 4.23). Flams were detected from May 9-July 21 – the first and last day of surveying! Detections were only slightly lower during the second ½ of the season (after ~ mid-June). Over the entire season, approximately ~35% of owls were calling prior to the broadcast call. Looking at just the first ½ of the season when we would expect owls to be calling spontaneously, just over 50% of detections were unsolicited.

We detected 243 Flammulated Owls across the Region; at least one owl was detected on 9% of points overall. On transects with owls detected at multiple points, it is often difficult to assess whether they are repeat detections from previous points. Therefore, in an effort not to over-count owl, we re-projected the point locations based on distance and bearing using GIS (see Figure 4). This exercise reduced the number of unique owls detected to approximately 206. However, we did not attempt to census the population, and this does not equate to owl abundance.

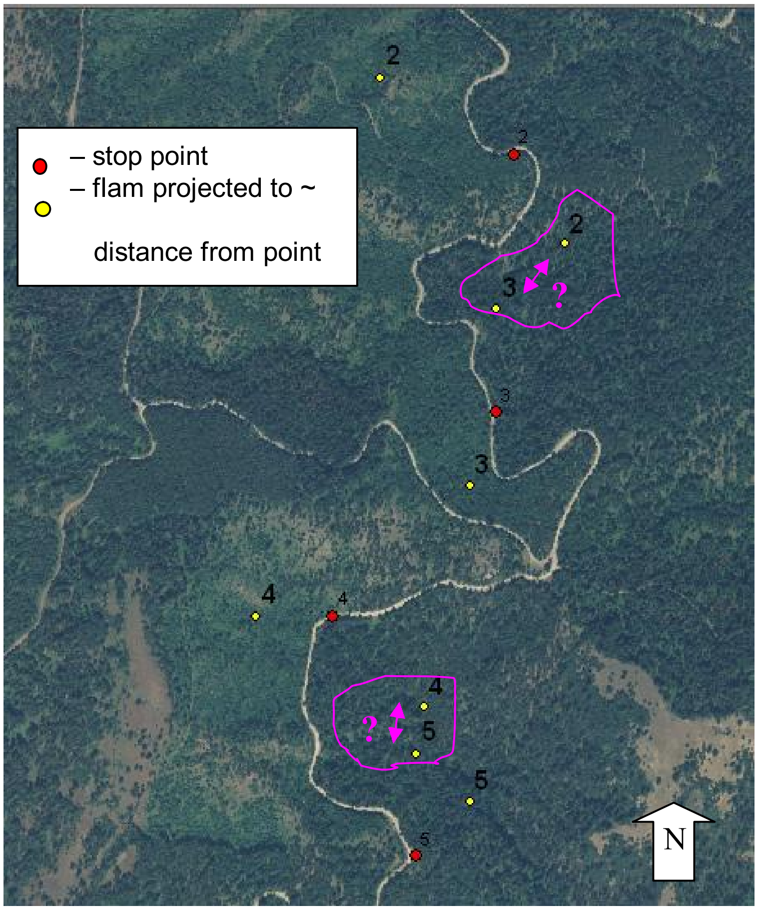

Fig. 4. Example of transect with owls likely detected at >1 point. For example, points 2 and 3 or 4 and 5, east of the road (Center ridge transect, Nez Perce NF).

We also tested to see whether playing a second round of broadcast call followed by an additional listening period (see methods) would result in enough additional detections to warrant the extra time. These "extended calls" were added to approximately 24 % of the points (usually points 2, 4 and 10), and added another 3 minutes/point to the survey time. Of the 88 extended calls in which owls were detected, 32 (36%) of the owls were NOT detected until after this second call and would otherwise have been missed.

OCCUPANCY:

Analytical tools allow us to estimate the probability of presence (or occupancy) across the Region and assess how this rates varied among individual forests. The primary assumptions associated with this analysis include closure (owls do not move into or out of sampling area between first and second visit) and approximate equal detection rate across forests and across the survey period.

In order to determine occupancy, we first assessed an overall detection probability. By visiting a randomly selected subset of the transects two times during the season and using the transect as the sampling unit, such calculations are possible (MacKenzie et al. 2006). Within the five forests with the highest likelihood for these owls, we randomly selected transects for resample.

Detection and occupancy rates were calculated by Dr. Jim Baldwin, USFS Pacific Southwest Station Statistician. Detection probability is the probability of detecting presence on a survey in a single visit, given that an owl was present. For this study detection probability was estimated to be 0.76 (SE 0.063).

We found that the forest with the highest occupancy rates was the Nez Perce, followed by the Lolo, Bitterroot, and Helena NFs (Table 2).

Table 2. 2005 Flammulated Owl results per National Forest.

FOREST	Prob. of presence [a]	Std error		No. trans FLAM yes	No. points FLAM yes	% pts FLAM yes
NEZ PERCE	0.747	0.115		16	69	0.22
LOLO	0.655	0.117		18	46	0.17
BITTERROOT	0.594	0.123		14	42	0.15
HELENA	0.512	0.120		11	41	0.16
BH-DL	0.359	0.139		5	10	0.06
KOOTENAI	0.324	0.090		9	26	0.07
FLATHEAD	0.132	0.126		1	4	0.04
CLEARWATER	0.120	0.081		2	2	0.01
IPNF	0.119	0.124		2	3	0.02
CUSTER	0	0		0	0	0
GALLATIN	0	0		0	0	0
LEWIS CLARK	0	0		0	0	0
TOTAL	**0.388**			**78**	**243**	**0.089305402**

[a]maximum likelihood estimates of the probabilities of presence at a transect for each forest.

OTHER OWLS:
Throughout the survey period, technicians also detected non-target owl species (see Table 3); some individuals vocalized spontaneously while others appeared to respond to the Flammulated Owl broadcast caller. Records for these incidental owls are included in the database available at http://avianscience.dbs.umt.edu/research_landbird_flam.htm.

Table 3. Owl species and the number of detections

OWL SPECIES	DETECTION S	OWL SPECIES	DETECTIONS
Great-Horned Owl	48	Western Screech-Owl	3
Barred Owl	23	Great-grey Owl	2
Northern Saw-whet Owl	21	Long-eared Owl	2
Northern Pygmy-Owl	5	Short-eared Owl	1
Boreal Owl	4		

DISCUSSION AND RECOMMENDATIONS

DESIGN AND PROTOCOL

Overall, the protocol established during this pilot season was effective. It is encouraging to have the Forests work together such that the data can be seamlessly pooled and inference expanded. We recommend Region 1 USFS adopt this protocol with minor adjustments as noted below. It is extremely valuable for all surveys to be conducted using the same data forms and methods (available @ http://avianscience.dbs.umt.edu/research_landbird_flam.htm). We hope continued monitoring of owls can occur on most if not all of the Forests on which we found owls.

Having the data available on our web site soon after collection has proven valuable. A few FS biologists have indicate the importance of adding these data to the FAUNA database, and the most efficient method for this needs to be assessed.

Site selection: Although creating a random selection of potential sites via GIS is a time-consuming process, this proved effective at giving us a scientifically sound pool from which to draw our sites. Survey sites were limited to those accessible by roads or trails (within 500 m). Although a truly random site selection without such a constraint would improve the scientific design, such design appears impractical given that these are nocturnal surveys with limited funding. Any off-road work would necessarily require paired technicians and additional time for off-road/trail hiking, and both these factors would significantly decrease survey effort or increase cost.

Survey Protocol: We recommend continuing the surveys in the manner as this pilot season, surveying every 500m in appropriate habitat. At this time, we recommend surveying each site 2 times in order to help refine our detection probabilities, understand how they may vary geographically and temporally, and improve confidence in our occupancy rate estimates. This double sampling recommendation could be relaxed over time, and any surveys that are not visited twice may still be used in analyses.

Based on the additional owls detected on those points in which we played the caller a second time (followed by an additional listening period), we recommend altering the protocol to reflect this. Specifically, we recommend 10 minutes per point – listen 2 minutes, play 1 minute, listen 3, play 1, listen 3.

Broadcast callers: The Foxpro broadcast callers, with required additional speaker for low-frequency vocalizations, were extremely reliable (http://www.gofoxpro.com/main.htm). Additionally, all technicians used these callers, with the same recording and volume, thus limiting observer variation. We strongly recommend these units for broadcast call surveys.

Vegetation sampling: Attempts to relate our vegetation data to Flammulated Owl presence/absence provided only limited information. Commonly, owl detections were estimated to be farther than the area sampled for vegetation. Additionally, because it is extremely hard to pinpoint owl locations, the accuracy of these estimates is questionable. More effort would need to be placed on methods to triangulate, track down, or spotlight to more accurately determine individual owl location. Therefore, for a broad-based monitoring protocol with a goal of tracking presence/absence over the long-term, we recommend taking

GPS spatial location data only and not sampling vegetation. With location data in-hand, one can always return (even post-season) to collect targeted data. Further, there are opportunities for relating owl locations with various vegetation layers through a GIS (see below).

Safety: There were no significant injuries or safety incidents, and technicians reported they felt reasonably safe working solo. A number of measures were taken to assure safety. A ½ day first aid course was completed at training. However, the service used for this (Missoula-based Z -Medical) was not sufficiently outdoor oriented or thorough, and we strongly recommend a one day Aerie Backcountry Medicine course for future LBMP work (http://www.aeriemed.com/). Additional safety measures were deemed adequate (e. g., FS radios and daily check-ins; pairing up with other technicians, FS employees, or volunteers for trail surveys; limited driving after survey was completed by camping as close to transect as feasible and locating camp prior to nocturnal survey).

ANALYSIS AND INFERENCE

Calculating a probability of presence on a Forest by Forest basis allows us to compare among Forests and begin to understand the extent to which any one Forest (and even District) may need to manage for Flammulated Owls and their associated habitat. Additional surveys on a yearly basis will allow us to improve our understanding of Flam distribution, reduce our standard errors, increase our confidence, and assess long-term trends.

Overall, 5 Forests appear to have important populations of Flammulated Owls (Table 2). They were found in only a few locales in the Clearwater and Flathead NFs, though continued monitoring may improve our understanding of their distributions on these Forests. The Lewis and Clark and Custer NFs were surveyed extensively with no detections, and from this we can infer that these Forests either have no Flammulated Owls or no significant populations worthy of management actions. On the Gallatin NF a few areas of potential Flam habitat were inaccessible in 2005 and may be worth visiting in future years.

By revisiting ~ 22 % of the transects (primarily on 5 forests), we were able to estimate a detection probability. The primary assumption with this analysis is that the detection does not change over the breeding season. We were not able to adequately test this assumption and strongly suggest additional assessment here. While we did find a change in the percentage of owls that were spontaneously hooting early to mid-season, this does not necessarily indicate that the owls were less willing to respond to our calls (assuming they were still territorial at the time). Unpaired males are known to hoot throughout the breeding season, whereas hooting of paired males dramatically declines after the pairs' eggs hatch (Reynolds and Linkhart 1987).

Weather: As mentioned, technicians were instructed not to conduct surveys if there was constant rain or snow (coded as SKY = 3 or 4) or severe wind (Beufort scale = 5 or greater). We removed from the database any surveyed points with such conditions. Early summer 2005 was particularly wet and cold, so our survey effort was less than expected. Additionally, others have found that even 24 hours after such inclement weather, owls were less detectable (V. Wright, pers comm.). We undoubtedly surveyed during these times and may have encountered fewer owls because of this. Additional repeated surveys will help us understand if our occupancy rates were low because of these early season conditions.

LOOKING AHEAD

Future Analysis: We plan to publish the results of this study in a peer-reviewed journal. We also plan to use these data together with a Geographic Information System to further assess Flammulated owl presence in relation to both forest type (via available vegetation layers) and broader landscape context (see Wright et al. 1997). These results can then be assessed in combination with those of Wright's, in order to better allow Forests to identify potentially occupied areas.

Additionally, there are a few more data sets available (which used the same protocol) that have yet to be merged with this one (Lolo NF – D. Wrobleski, Bitterroot Valley – D. Casey).

Future Studies: We did not search for nests or in any other way determine breeding status. Because Flammulated Owls are rarely seen during daylight hours, nests are particularly time-consuming to locate. We also did not attempt to spotlight or otherwise visually locate these owls. Future studies could, of course, assess breeding status and vital rates in relation to habitat characteristics in order to better understand Flam habitat requirements. Nest box studies are potentially feasible.

At the spring 2006 meeting of the Western Working Group of Partners in Flight (WWG-PIF), the initiation of a West-wide Flammulated Owl survey emerged as a high priority for this group. With so much emphasis across the west on forest thinning and restoration in areas presumed to be Flam habitat, the need for better habitat information and long-term trend monitoring was agreed upon. A committee was formed consisting of individuals from Colorado, Idaho, Montana, Oregon, and Washington, with a plan to develop a standardized protocol to be used throughout the region (stemming in large part from R1's efforts here). Ideally, various states and agencies would adopt the protocol, secure funds, and begin sampling during the summer of 2007. This might be an effort using paid technicians, citizen scientists, or some combination of the two. The committee will discuss these ideas in the fall of 2006 and hopes to reconvene at the next WWG-PIF meeting. In this Region, it will be important to involve MT Fish Wildlife and Parks, the Salish and Kootenai tribes, and private land owners in future studies.

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